Background of the Invention

Field of the Invention

This invention relates to water filters and more particularly, to an underwater filtration operator which can be positioned in a water body to filter and disinfect water from the water body for drinking or other purposes. The underwater filtration operator includes a housing having a selected configuration and divided into multiple filtration units which receive water from the water body, each of which filtration units includes at least one filter for filtering the water. A pump is provided in the housing for pumping the filtered water to a suitable container or dispenser.

Treatment processes for filtering surface water have remained virtually unchanged for over half a century. Many surface water treatment plants utilize large settling basins, known as clarifiers, to settle out heavy solids from water prior to fine-screening the water using rapid sand filters. Some of these treatment plants use a mixing chamber clarifier to separate the heavy solids from the water. Such a mixing chamber clarifier requires the introduction of polymers, lime, alum or other types of media into the water to be treated, which media bind particulate impurities in the water and fall with the bound impurities to the bottom of the mixing chamber. The filtered water, substantially devoid of the larger impurities, is then processed through horizontal sand filters which remove smaller impurities from the water. The sand filters must be periodically backwashed using copious quantities of clean water because they repeatedly become clogged with the smaller particles that were not removed from the water during the clarification process. The fewer the particles removed during the clarification process, the more often the backwashing procedure must be repeated.

The foregoing types of surface water treatment plants are associated with many problems due to the nature of their operation. Numerous pumps and an elaborate intake structure must be installed

in the water supplies to conduct the water to the plants for treatment. Another problem involves the disposal of solids that are removed from the water. Formerly these solids, along with the chlorine, polymers, lime or other particulate binding media, were pumped back into the pre-filtered water from which they were removed. Due to recent environmental legislation, however, it is no longer lawful to discharge the particulate binding media into the pre-filtered water supply, as these materials are not endemic to the water that is being treated. Another problem associated with these filtration systems is that the polymers or other particle binding media introduced into the filtration system are harmful to certain types of boiler water industrial filtration which utilizes reverse osmosis. This increases the cost of boiler water for industrial consumers. Furthermore, disinfectant chemicals introduced into the filtered water do not always kill all parasites found in water sources. Rapid sand filters cannot remove all of these parasites, some of which remain in the water and cause a severe health risk. Another problem associated with these surface water treatment plants is the inability to remove harmful chemicals which may contaminate the water supply by agricultural run-off or accidental spills. Furthermore, constructing surface treatment plants can be costly and time-consuming.

A number of different types of filters are known in the art for filtering surface water. Patents of interest in this regard include U.S. Pat. Nos. 4,606,819; 4,643,836; 4,657,672; 4,950,393; 5,160,039; 5,549,828; and 6,027,639.

An object of this invention is to provide an underwater filtration operator capable of filtering water from a lake, pond or other water body.

Another object of this invention is to provide a self-contained underwater filtration operator which is simple in construction and operation.

Still another object of this invention is to provide an underwater filtration operator which includes a housing, multiple filtration units provided in the housing for receiving the water, at least one filter provided in each filtration unit for filtering the water and a pump provided in the housing for pumping the filtered water to a collection container or dispenser.

Summary of the Invention

These and other objects of the invention are provided in an underwater filtration operator which can be suspended in a lake, pond or other water body to filter water from the water body. The underwater filtration operator includes a housing having a selected configuration and divided into multiple filtration units, each of which includes at least one filter for filtering water from the water body. A pump is provided in the housing for receiving the filtered water from the filtration units and pumping the filtered water to a suitable collection facility or dispenser.

Brief Description of the Drawings

The invention will be better understood by reference to the accompanying drawings, wherein:

FIGURE 1 is a perspective view, partially in section, of an illustrative embodiment of the underwater filtration operator of this invention;

FIGURE 2 is a top view, with the top housing panel element removed, of the underwater filtration operator illustrated in FIGURE 1;

FIGURE 3 is an exploded, perspective view of a screen grid element of the underwater filtration operator;

FIGURE 4 is a sectional view, taken along section line 3 in FIGURE 2, of the underwater filtration operator;

FIGURE 5 is a sectional view, taken along section lines 5-5 in FIGURE 1, of the underwater

filtration operator; and

FIGURE 6 is a top view, with the top housing panel element removed, of another embodiment of the underwater filtration operator, illustrating an alternative configuration for the housing of the underwater filtration operator.

Description of the Preferred Embodiments

Referring to the drawings, an illustrative embodiment of the underwater filtration operator of this invention is generally illustrated by reference numeral 1. The underwater filtration operator 1 is designed for floatation or otherwise positioning in a water body 43 (FIGURE 5) such as a pond or lake to filter and disinfect water from the water body 43 for drinking or other purposes, as hereinafter described. The underwater filtration operator 1 includes a housing 2 which, as illustrated in FIGURES 1 and 2 can be octagonal in shape or alternatively, cylindrical, as illustrated in FIGURE 6, or any other suitable shape. The housing 2 includes an outer wall 3, and has a top housing panel 4 and a bottom housing panel 5 (FIGURE 5) which, with the outer wall 3, enclose multiple filtration units 8, separated from each other in the housing 2 by means of partitions 6 which extend from the outer wall 3 and between the top housing panel 4 and the bottom housing panel 5. While the embodiment of the underwater filtration operator 1 illustrated in the drawings includes eight filtration units 8, it is understood that any number of filtration units 8 can be contained in a housing 2 of any desired size and shape. As illustrated in FIGURES 2 and 6, each filtration unit 8 includes an outermost raw water chamber 17, separated from an outer filter chamber 13 by means of an outer screen grid 9. The outer filter chamber 13 of each filtration unit 8 is separated from an inner filter chamber 14 by means of a middle screen grid 9, while the inner filter chamber 14 is separated from an innermost filtered water chamber 15 by means of an innermost screen grid 9. As illustrated in

FIGURE 5, three retention plates 46 extend downwardly from the top housing panel 4 in spaced-apart relationship to each other, and each of the screen grids 9 is mounted on a corresponding one of the retention plates 46 to define the outer filter chamber 13 and the inner filter chamber 14, respectively. As hereinafter further described, the outer filter chamber 13 contains a selected outer filter medium 13a, such as coal, for example, and the inner filter chamber 14 contains a selected inner filter medium 14a, such as, for example, sand. It will be appreciated by those skilled in the art that the outer filter chamber 13 and the inner filter chamber 14 can be any desired size to contain any desired volume of any selected filter medium, including sand, coal, or reverse osmosis filters (not illustrated), in non-exclusive particular, by varying the relative spacing of the adjacent screen grids 9 with respect to each other, depending on the degree of filtration desired for the outer filter chamber 13 and the inner filter chamber 14, respectively. Each of the screen grids 9 is designed to contain the selected particulate outer filter medium 13a or inner filter medium 14a in the outer filter chamber 13 or inner filter chamber 14, respectively, of each filteration unit 8. Accordingly, as illustrated in FIGURE 3, each screen grid 9 typically includes a sieve screen 11, sandwiched between a pair of expanded metal screens 10. The screen openings 11a of each sieve screen 11 are smaller in size than the particles of the outer filter medium 13a or inner filter medium 14a, respectively, to prevent inadvertent movement of the outer filter medium 13a and inner filter medium 14a beyond the confines of the outer filter chamber 13 and the inner filter chamber 14, respectively. As further illustrated in FIGURE 5, an air space 47 is defined between the bottom surface of the top housing panel 4 and the outer filter medium 13a and the inner filter medium 14b, in the outer filter chamber 13 and the inner filter chamber 14, respectively. As illustrated in FIGURES 1 and 5, top chamber access openings 4a are typically provided in the top housing panel 4, and bottom chamber access openings 5a are

typically provided in the bottom housing panel 5, for accessing the outer filter chamber 13 and the inner filter chamber 14, respectively, of each filtration unit 8, as necessary. The top chamber access openings 4a and bottom chamber access openings 5a can be closed typically by means of removable or pivoting opening caps 7.

Referring again to FIGURE 5 of the drawings, the filtered water chamber 15 of each filtration unit 8 communicates with a pump chamber 16, defined by a pump housing 23 provided at substantially the center of the housing 2. The pump housing 23 is typically defined by pump housing panels 22a which extend upwardly from a pump housing bottom 22b, and multiple housing openings 22c establish communication between the pump chamber 16 and the respective filtered water chambers 15. A water pump 24, the purpose of which will be hereinafter described, is provided in the bottom of the pump chamber 16. The bottom housing panel 5 extends outwardly from the central pump housing 23 and is typically omitted from the raw water chamber 17 portion of each filtration unit 8, to define between the outer wall 3 and the outer edge of the bottom housing panel 5, an intake space 17a which establishes communication between the outside of the housing 2 and the raw water chamber 17. In another embodiment (not illustrated), the bottom housing panel 5 extends from the pump housing 23 and is attached to the inside surface of the outer wall 3 to close the bottom of the respective raw water chambers 17, and multiple intake openings (not illustrated) extend through the bottom housing panel 5 at the raw water chambers 17. The pump housing 23 extends upwardly through the top housing panel 4 of the housing 2 and communicates with the filtered water chambers 15 and the pump chamber 16, and is typically closed by a removable cap 30. A filtered water discharge tube 26, provided in fluid communication with the water pump 24, extends upwardly from the water pump 24 and through an air-sealed opening (not illustrated) provided in the cap 30, and is

typically fitted with a discharge valve 27 for selectively opening and closing the filtered water discharge tube 26. A T-shaped air introduction tube 31, fitted with an air supply valve 34 and having a lower arm 31a which extends downwardly through an air-sealed opening (not illustrated) in the cap 30 and an upwardly-extending upper arm 31b typically fitted with a main vent valve 33, is connected to a source of compressed air (not illustrated) for selectively introducing pressurized air into the housing 2 for purposes hereinafter described. A housing flotation collar 20, constructed of STYROFOAM (trademark) or other suitable buoyant material, or having an inner flotation chamber (not illustrated), is mounted on the housing 2 and encircles the upper portion of the pump housing 23 to impart buoyancy to the underwater filtration operator 1 in a water body 43, as hereinafter described. A disinfectant tube 40 typically extends downwardly through the top housing panel 4, into the raw water chamber 17 of one or more of the filtration units 8 to facilitate introducing a chemical disinfectant such as chlorine into the raw water chamber 17, typically through a valve 41 provided in the disinfectant tube 40, as deemed necessary. An air vent tube 37 further extends through the top housing panel 4 and into the raw water chamber 17 of each of the filtration units 8 to facilitate releasing pressurized air from the housing 2 typically through an air vent valve 38 provided in each air vent tube 37, as hereinafter described.

Referring again to FIGURE 5 of the drawings, in typical operation of the underwater filtration operator 1, the filtered water discharge tube 26 is connected to a suitable water collection container or dispenser (not illustrated) and the air introduction tube 31 is connected to a source of pressurized air (not illustrated). With both the main vent valve 33 in the upper arm 31b of the air introduction tube 31 and the air vent valves 38 of the respective air vent tubes 37 in the closed position, the housing 2 is placed on the water body 43 such that the housing 2 initially floats on the water body

43, due to air trapped between the surface of the water body 43 and the top housing panel 4 inside the housing 2. The main vent valve 33 and the air vent valves 38 are next opened to facilitate escape of air from the housing 2 through the respective lower arm 31a and upper arm 31b of the air introduction tube 31 and the air vent tubes 37, which escape of air from the housing 2 causes the housing 2 to slowly descend into the water body 43. The housing 2 is finally suspended just beneath the surface of the water body 43, as illustrated, typically by means of buoyancy imparted to the housing 2 by means of the flotation collar 20. As the housing 2 descends into the water body 43, raw water from the water body 43 is drawn first into the raw water chamber 17 of each filtration unit 8 through the respective intake spaces 17a, and then through the outer screen grid 9, the outer filter medium 13a, the middle screen grid 9, the inner filter medium 14a, and finally, through the inner screen grid 9 of the corresponding filtration unit 8, into the filtered water chamber 15. After the housing 2 reaches the final suspension level in the water body 43, the main vent valve 33, the air supply valve 34 and the air vent valves 38 are closed, and the water pump 24 is then operated to pump the filtered water upwardly through the filtered water discharge tube 26 and the open discharge valve 27, and finally, into the filtered water collection tank or dispenser (not illustrated). Continued operation of the water pump 24 facilitates continuous flow of the water from the water body 43, through the outer filter medium 13a, the inner filter medium 14a, the filtered water chamber 15, the filtered water discharge tube 26 and into the water collection container or dispenser, respectively. As the water is drawn through the outer filter chamber 13 and the inner filter chamber 14, respectively, the outer filter medium 13a and the inner filter medium 14a remove both large and small particulate impurities, as well as bacteria and microorganisms, from the water. It will be appreciated by those skilled in the art that as the water flows through the filtration units 8 and is pumped through

the filtered water discharge tube 26 into the water collection tank or dispenser, chlorine or other disinfectant chemicals can be introduced into the pre-filtered water through the disinfectant tube 40 by opening the disinfectant valve 41, to kill bacteria, algae and other microorganisms and ensure filtered water containing few or no live bacteria, algae or microorganisms which may otherwise evade the filtering process. The outer filter medium 13a and the inner filter medium 14a can be removed from the outer filter chamber 13 and the inner filter chamber 14, respectively, and replaced with fresh or alternative filter medium, as deemed necessary, by accessing the outer filter chamber 13 and the inner filter chamber 14, respectively, through the top chamber access openings 4a and the bottom chamber access openings 5a.

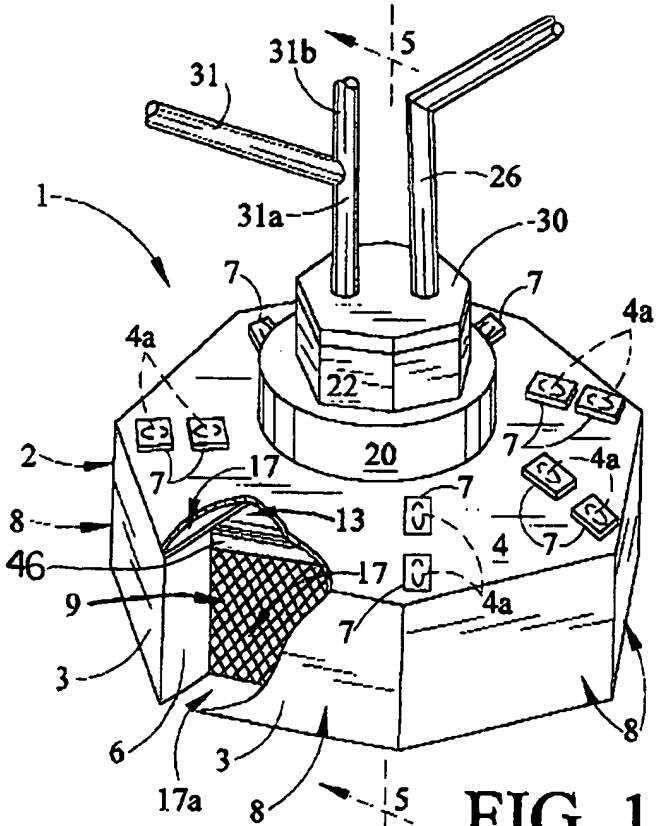
It will be appreciated by those skilled in the art that the underwater filtration operator 1 can be selectively operated in a backwash cycle to remove impurities, filtered from the water, from the outer filter medium 13a and the inner filter medium 14a, respectively, by reversing the direction of water flow through the respective filtration units 8. This is accomplished by initially terminating operation of the water pump 24; closing the main vent valve 33; opening the air vent valves 38 of the respective air vent tubes 37; and pumping air into the filtered water chamber 15 from the source of compressed air (not illustrated), through the air introduction tube 31 and lower arm 31a of the air introduction tube 31 by opening the air supply valve 34. This action forces filtered water in the filtered water chamber 15, through the inner filter medium 14a in the inner filter chamber 14 and the outer filter medium 13a in the outer filter chamber 13, respectively, and into the raw water chamber 17 of each corresponding filtration unit 8. This reverse flow of water through the inner filter medium 14a and the outer filter medium 13a, respectively, of each filtration unit 8, in combination with pressurized air discharged from the air introduction tube 31 into the filtered water in the filtered water

chamber 15, removes all or most of the filtered particles and microorganisms from the inner filter medium 14a and the outer filter medium 13a of each filtration unit 8, and discharges these impurities into the water body 43 through the intake spaces 17a. Furthermore, when the air is forced through the inner filter medium 14a and the outer filter medium 13a, the air space 47 in each inner filter chamber 14 and outer filter chamber 13 enables the inner filter medium 14a and the outer filter medium 13a to expand and fill the entire volume of the respective inner filter chamber 14 and outer filter chamber 13. Accordingly, the inner filter medium 14a and outer filter medium 13a become fluid in the inner filter chamber 14 and the outer filter chamber 13, respectively, and this facilitates thorough cleansing of the inner filter medium 14a and outer filter medium 13a.

Referring again to FIGURE 5 of the drawings, it will be appreciated by those skilled in the art that the flotation collar 20 is particularly suitable for suspending the housing 2 beneath the surface of the water body 43 under circumstances in which the level of the water body 43 is subject to fluctuating water levels. Alternatively, it is understood that the housing 2 can be positioned beneath the surface of the water body 43 by securing the housing 2 to a dock, barge, piling or the like. It will be further appreciated by those skilled in the art that the controls for the filtered water discharge valve 27, the main vent valve 33, the air supply valve 34, the air vent valves 38 and the disinfectant valve 41, respectively, may be provided in a land-based control panel (not illustrated) for convenient, expedient and/or automated operation of the underwater filtration operator 1.

While the preferred embodiments of the invention have been described above, it will be recognized and understood that various modifications can be made in the invention and the appended claims are intended to cover all such modifications which may fall within the spirit and scope of the invention.

Having described my invention with the particularity set forth above, what is claimed is: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17a

FIG. 1

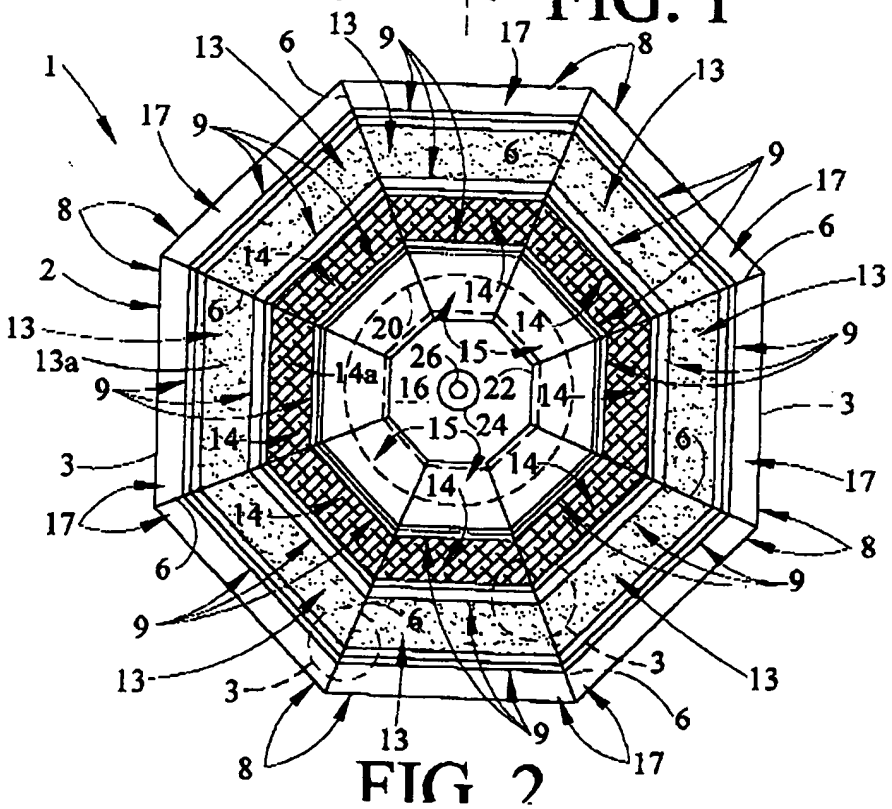
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FIG. 2

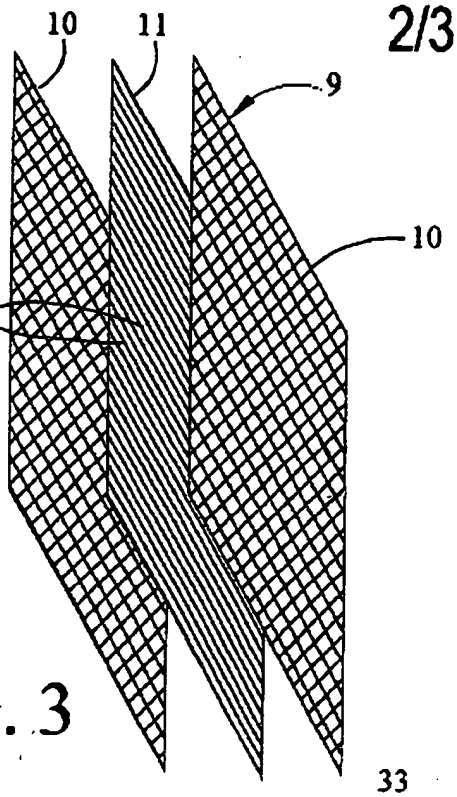

FIG. 3

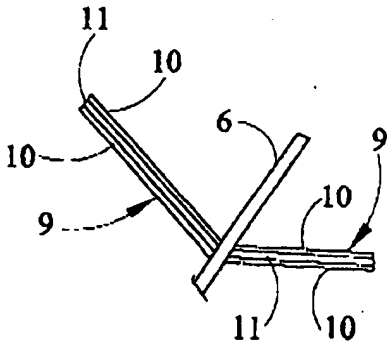

FIG. 4

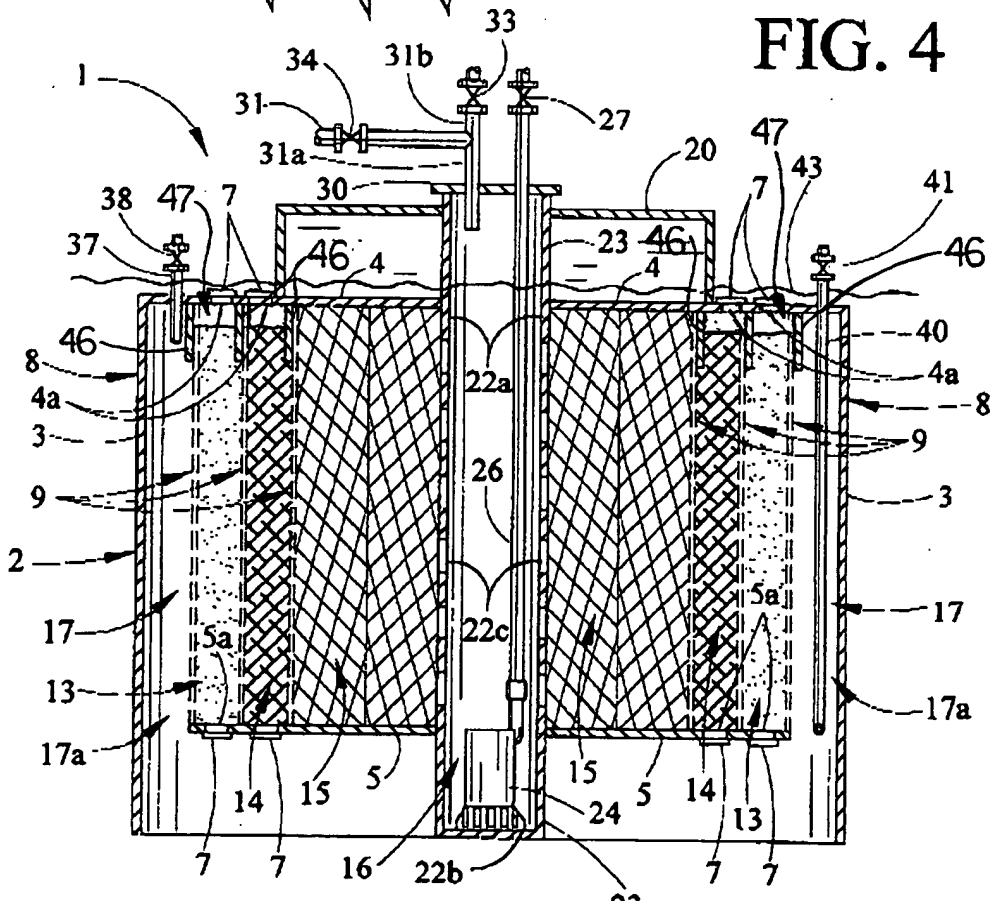

FIG. 5

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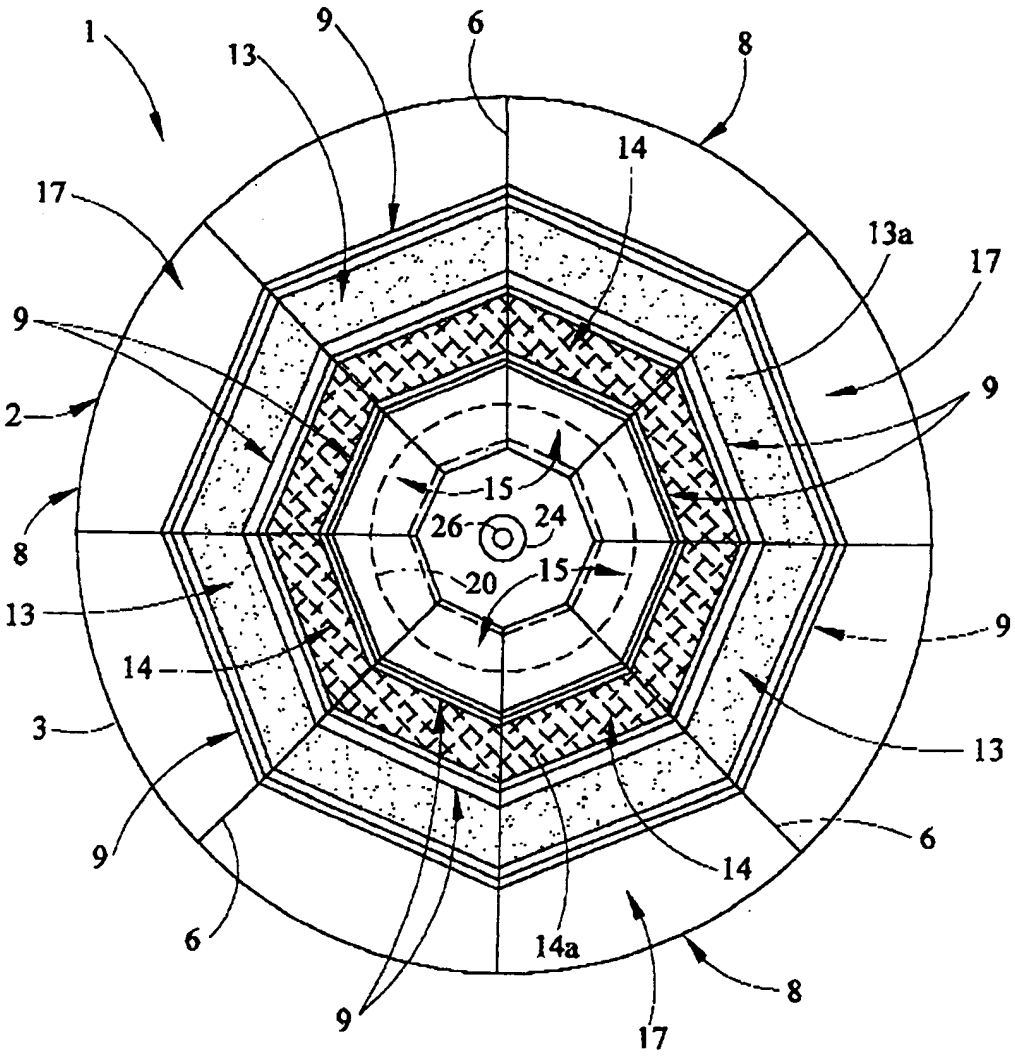

FIG. 6

1. An underwater filtration operator for filtering water in a water body, comprising:

a housing;

a plurality of filtration units provided in said housing;

at least one filter provided in said plurality of filtration units, respectively, for receiving the water from the water body;

a pump chamber provided in said housing for receiving the water from said plurality of filtration units, respectively; and

a water pump provided in said pump chamber for pumping the water from said housing.

2. The underwater filtration operator of claim 1 wherein said at least one filter comprises a pair of filters provided in adjacent relationship to each other in said plurality of filtration units, respectively.

3. The underwater filtration operation of claim 1 comprising a housing flotation collar provided on said housing for floating said housing in the water body.

4. The underwater filtration operator of claim 3 wherein said at least one filter comprises a pair of filters provided in adjacent relationship to each other in said plurality of filtration units, respectively.

5. The underwater filtration operator of claim 1 wherein at least one of said at least one filter comprises a sand filter.

6. The underwater filtration operator of claim 5 wherein said at least one filter comprises said sand filter and a second filter provided in adjacent relationship to each other in said plurality of filtration units, respectively.

7. The underwater filtration operator of claim 5 comprising a housing flotation collar provided on said housing for floating said housing in the water body.

8. The underwater filtration operator of claim 7 wherein said at least one filter comprises said sand filter and a second filter provided in adjacent relationship to each other in said plurality of filtration units, respectively.

9. The underwater filtration operator of claim 1 comprising a raw water chamber provided in said housing for receiving the raw water from the water body.

10. The underwater filtration operator of claim 9 wherein said at least one filter comprises a pair of filters provided in adjacent relationship to each other in said plurality of filtration units, respectively.

11. The underwater filtration operator of claim 9 comprising a housing flotation collar provided on said housing for floating said housing in the water body.

12. The underwater filtration operator of claim 11 wherein said at least one filter comprises

a pair of filters provided in adjacent relationship to each other in said plurality of filtration units, respectively.

13. The underwater filtration operator of claim 9 wherein at least one of said at least one filter comprises a sand filter.

14. The underwater filtration operator of claim 13 wherein said at least one filter comprises said sand filter and a second filter provided in adjacent relationship to each other in said plurality of filtration units, respectively.

15. The underwater filtration operator of claim 13 comprising a housing flotation collar provided on said housing for floating said housing in the water body.

16. The underwater filtration operator of claim 15 wherein said at least one filter comprises said sand filter and a second filter provided in adjacent relationship to each other in said plurality of filtration units, respectively.

17. An underwater filtration operator for filtering water in a water body, comprising:

a housing;

a plurality of filtration units provided in said housing;

at least one filter provided in said plurality of filtration units, respectively, for receiving the water from the water body;

a pump chamber provided in said housing for receiving the water from said plurality of filtration units, respectively;

a water pump provided in said pump chamber for pumping the water from said housing; and

a source of compressed air provided in pneumatic communication with said pump chamber for selectively introducing compressed air into said pump chamber and forcing the water from said pump chamber, through said at least one filter and into the water body and cleaning said at least one filter.

18. The underwater filtration operator of claim 17 wherein said at least one filter comprises a pair of filters provided in adjacent relationship to each other in said plurality of filtration units, respectively.

19. The underwater filtration operator of claim 17 comprising a housing flotation collar provided on said housing for floating said housing in the water body.

20. An underwater filtration operator for filtering water in a water body, comprising:

a housing;

a plurality of filtration units provided in said housing;

at least one filter provided in said plurality of filtration units, respectively, for receiving the water from the water body;

a pump chamber provided in said housing for receiving the water from said plurality of filtration units, respectively;

a water pump provided in said pump chamber for pumping the water from said housing;

a source of compressed air provided in pneumatic communication with said pump chamber for selectively introducing compressed air into said pump chamber and forcing the water from said pump chamber, through said at least one filter and into the water body and cleaning said at least one filter; and

a disinfectant tube extending into said housing for introducing disinfectant into said housing.